CONTINUING MEDICAL EDUCATION

The Treatment of Hallux Valgus

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SUMMARY

Background: Hallux valgus is the commonest forefoot deformity, with an estimated prevalence of 23% to 35%. It causes symptoms on the medial edge of the foot, the sole, and the small toes. Non-operative treatment may alleviate symptoms but does not correct the deformity of the big toe. Surgery is indicated if the pain persists. The correct operation must be selected from a wide variety of available techniques.

Methods: In this article, we selectively review the pertinent literature, including the recommendations of medical societies in Germany and abroad, in the light of our own clinical experience.

Results: There have been many clinical trials of various treatments for hallux valgus, but very few of these were randomized, and the case numbers were generally small. Mild deformities are best treated by distal first metatarsal osteotomies, e.g. the Chevron osteotomy. Severe deformities require a soft-tissue procedure at the first metatarsophalangeal joint and a proximal first metatarsal osteotomy. In case of osteoarthritis, and in elderly patients, a resection arthroplasty is preferred; arthrodesis is performed in physically active patients. After correction of hallux valgus, patients can usually bear their full weight on the treated foot while wearing a flat surgical shoe. Proper surgical treatment results in a good or very good outcome in 85% of patients and a satisfactory result in a further 10%.

Conclusion: The clinical outcome of present treatments seems to be good in most cases, but large-scale randomized trials are still needed to verify the efficacy of the wide variety of operations and fixation techniques that are currently being offered.

► Cite this as:
Wülker N, Mittag F: The treatment of hallux valgus. Dtsch Arztebl Int 2012; 109(49): 857–68.
DOI: 10.3238/arztebl.2012.0857

No deformity of the forefoot occurs more frequently than hallux valgus. A recent review estimates the global prevalence of hallux valgus at up to 23% in 18- to 65-year-olds and 35% in those over 65, although of course it is difficult to draw a line between normal and pathological positioning of the great toe (1). The reasons for hallux valgus in an individual case are hard to define: The deformity can often be attributed to ill-fitting shoes, and sometimes there is a familial disposition. Women are much more commonly affected than men, because they frequently wear narrow, high-heeled shoes and often have more flexible soft tissues (2). Although hallux valgus is particularly frequent from the middle years of life upwards, many patients of both sexes are affected at a young age, usually in one foot but sometimes in both (1–3, e1–e3).

The pathogenesis of hallux valgus is complex. It is generally accepted that an imbalance of the extrinsic and intrinsic foot muscles and the ligamentous structures is involved. Even in the normal foot, the extensor and flexor tendons are slightly off-center to lateral. This is compensated by other foot muscles and ligaments, however, so that overall the forces are balanced. This equilibrium is sensitive to internal and external influences (e.g., the wearing of narrow, high-heeled, and pointed shoes). The energy required to maintain the developing deformity becomes ever smaller. The eventual result is valgus deformity of the great toe with spreading of the forefoot (3–6, e3).

Hallux valgus causes symptoms in three particular ways. First and foremost is pain in the bunion, the pressure-sensitive prominence on the medial side of the head of the first metatarsal. It hurts to wear a shoe. Furthermore, the valgus deviation of the great toe often results in a lack of space for the other toes. They become displaced, usually upwards, leading to pressure against the shoe. This is termed hammer toe or claw toe. Finally, normal function of the forefoot relies heavily on the great toe pressing down on the ground

Symptoms

Hallux valgus causes pain particularly in the bunion on the inner side of the foot, on loading under the foot and in the smaller toes

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Figure 1: Hallux valgus with a hallux valgus angle of 20° and pain from pressure on the bunion medially

during gait. Since the valgus deformity stops this happening to a sufficient degree, metatarsal heads II–V are overloaded. The resulting pain is referred to as transfer metatarsalgia.

Learning goals

The learning goals for readers of this article are:

- The ability to distinguish accurately between the different variants of hallux valgus deformity
- Attainment of familiarity with the possibilities and limitations of conservative, symptomatic treatment of hallux valgus
- The ability to decide when surgery is indicated
- Acquaintance with the various surgical procedures and the indications for each particular method.

Diagnosis

The lateral deviation of the great toe is obvious when the patient stands barefoot *(Figure 1)*. In addition, one can measure the angle between the longitudinal axes of the first metatarsal and the proximal phalanx of the great toe, with the vertex at the head of the first metatarsal (hallux valgus angle). An angle greater than 15° no longer corresponds to the norm, although there is considerable interindividual variation (3). The valgus position of the great toe is not the only deformity. In the majority of cases the metatarsus is splayed, increasing the prominence of the metatarsophalangeal joint. Moreover, the great toe is often somewhat pronated, so that the nail faces medially. The examiner should also establish whether the deformity is flexible, i.e., whether it can be corrected by manipulation, and whether motion of the metatarsophalangeal joint is limited by pain, which would point to osteoarthritis. Furthermore, the stability of the first tarsometatarsal joint should be determined. The tarsus and hindfoot must also be investigated to exclude accompanying deformities. Investigation of peripheral vascular perfusion and motor and sensory functions is obligatory.

A dorsoplantar radiograph with the foot under load is required. An additional lateral or oblique view in this position contributes little extra information because the bones are superimposed, but may help to depict deformities of the smaller toes and instability of neighboring joints. Only under conditions of loading can the angle between the first and second metatarsals (intermetatarsal angle) be determined accurately. The radiograph will show the congruence of the metatarsophalangeal joint, i.e., whether a subluxation exists, and should also be inspected for any signs of osteoarthritis (joint space narrowing, subchondral sclerosis).

Conservative treatment

Only while the skeleton is still growing can the position of the great toe be improved with lasting effect. A night splint can be prescribed to move the great toe to medial. After the end of growth, adequate correction is no longer possible and conservative treatment is restricted to alleviation of symptoms.

By the time patients consult a physician, most of them have already resorted to softer and wider shoes to alleviate pain from pressure on their bunion. Ring pads and other dressings tend to increase the prominence of the bunion and are usually unsuccessful. Antiphlogistic salves can be administered locally, nonsteroidal anti-inflammatory drugs systemically.

Pain in the smaller toes can be alleviated with pads and toe straighteners. Wide, soft shoes are helpful if they give the toes enough space. Once hammer toes or claw toes have developed, however, surgery is necessary.

In our experience, insoles are effective for alleviation of metatarsalgia (7). They must feature a pad that pushes the metatarsals upward proximal to the

Radiograph

A radiograph with the patient in standing position shows the angle between metatarsal I and metatarsal II, as well as the congruence of the first metatarsophalangeal joint and any signs of osteoarthritis.

Conservative treatment

Pain on standing and walking can be alleviated by inlays under the forefoot. Permanent improvement of the position of the great toe is not possible.

TABLE 1

A selection of well-known surgical procedures for treatment of hallux valgus

No.	Name	Principle	Site	References	Advantages/disadvantages	Comments
1	Akin	Corrective osteotomy	Proximal phalanx	Akin (1925) (8), Arnold (2008) (e4), Chacon et al. (2012) (9)	In combination with other techniques, stability technically difficult	Used in hallux valgus interphalangeus
2	Metatarsophalangeal joint arthrodesis	Fusion	Metatarsophalangeal joint	Kumar et al. (2010) (10)	Permanent correction, loss of mobility, subsequent osteoarthritis	Used in severe deformities and/or hallux rigidus
3	Basal osteotomy	Corrective osteotomy	Metatarsal I, proximal	Mann (1992) (11), Wülker (2005) (12)	In combination with soft tissue intervention, stability technically difficult, implant necessary, not possible if tarsometatarsal joint is unstable	Suitable for correction of severe deformities
4	Chevron	Corrective osteotomy	Metatarsal I, distal	Austin (1981) (13), Wülker (2005) (12)	Reliable technique, little soft tissue trauma, implant necessary, not possible with severe deformity, reduced perfusion of head of metatarsal I	Used in mild deformities
5	Hohmann	Corrective osteotomy	Metatarsal I, distal	Hohmann (1923) (14)	Little stability with wires or sutures, reduced perfusion of head of metatarsal I	Now hardly ever used
6	Hueter	Resection arthroplasty	Metatarsal I, head	Hueter (1871) (15), Mayo (1908) (e6)	Simple technique, lack of support for head of metatarsal I, transfer metatarsalgia frequent	No longer used
7	Keller-Brandes	Resection arthroplasty	Proximal phalanx, proximally	Keller (1904) (16), Brandes (1929) (17)	Simple technique, loss of hallux function, transfer metatarsalgia frequent	Used in elderly and inactive patients
8	Kramer	Corrective osteotomy	Metatarsal I, distal	Kramer (1990) (18)	Little stability with wires, reduced perfusion of head of metatarsal I	Now hardly ever used
9	Lapidus	Fusion	Tarsometatarsal joint	Lapidus (1934) (19), Taylor et al. (2008) (20), Hyer et al. (2011) (e7)	In combination with soft tissue intervention, implant necessary, loss of mobility, technically difficult, danger of pseudarthroses	Used in cases of TMT-I joint instability or osteoarthritis
10	McBride	Soft tissue balancing with repositioning of the adductor tendon	Metatarsophalangeal joint	McBride (1928) (21)	Frequent recurrence owing to inadequate correction of metatarsal I	Now hardly ever used, replaced by soft tissue procedure
11	Scarf	Corrective osteotomy	Metatarsal I, diaphyseal	Patton et al. (1994) (e8), Weil (2000) (22), Adam et al. (2011) (e9)	Accurate correction angle, implant necessary, extensive soft tissue dissection	Suitable for correction of mild to moderate deformities
12	Soft tissue procedure	Soft tissue balancing	Metatarsophalangeal joint	Mann (1992) (4)	Complete soft tissue correction, two skin incisions necessary	Usually in combination with proximal osteotomy

Surgical procedures

The different surgical procedures are based on various underlying principles, e.g., correction osteotomy, resection arthroplasty, or arthrodesis.

Disadvantage of some operative techniques

A disadvantage of some operative techniques is reduced perfusion of the head of metatarsal I.

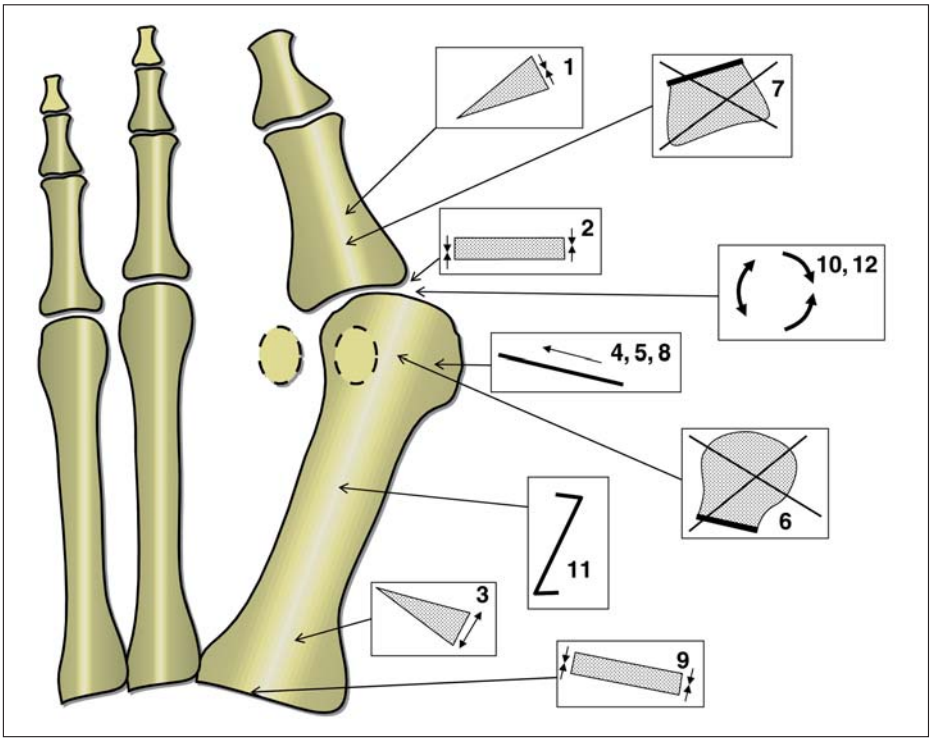


Figure 2:
Sites of surgical procedures for treatment of hallux valgus. The numbers correspond to those in Table 1 (first column).

pressure-sensitive heads. It often suffices to advise the patient to wear shoes with soft soles and without excessively high heels (no more than 4 cm). The malposition of the great toe, of course, cannot be corrected with insoles alone.

Study findings

Over 150 different operations have been described for the treatment of hallux valgus. A selection of better-known procedures is presented in *Table 1* and *Figure 2*.

There are only a small number of prospective randomized trials comparing different surgical procedures or investigating conservative treatment *(Table 2)*. The whole published literature contains only four publications (23, 29–31) in which operative techniques were compared, none of which reached any clear conclusions. This shows the limits of current scientific knowledge, particularly when it comes to detailed questions of surgery. Whether, for example, the adductor tendon must be divided or the intermetatarsal angle corrected has to be decided according to the patient's specific deformity. These techniques can hardly be randomized without taking account of the exact deformity. The wide variety of deformities would necessitate very large numbers of cases, involving the cooperation of many different centers. For this reason, prospective randomized trials concern themselves with details of surgical technique or compare very similar operations. The actual choice of procedure over the whole spectrum of hallux valgus deformities thus depends essentially on the surgeon's expertise and experience.

A Cochrane review by a group of podiatrists in London, originally published in 2004 and updated in 2009, analyzed a total of 21 randomized or "quasi-randomized" clinical trials that were essentially equivalent to the studies listed in *Table 2* with regard to operative technique. The conclusion: "The methodological quality of the […] trials was generally poor and trial sizes were small." No difference was found between conservative treatment and no treatment. No recommendations were given with regard to operative techniques. Trials of operative techniques have yielded

Metatarsalgia

In our experience, metatarsalgia can be effectively alleviated with insoles. These must have a pad that exerts upward pressure on the metatarsals proximal to the pressure-sensitive metatarsal heads.

Study findings

The literature contains only few prospective randomized trials comparing different surgical procedures or investigating conservative treatment. Four studies that did compare procedures all came to no clear conclusion.

TABLE 2

Randomized clinical trials of hallux valgus surgery

Study [reference]	Comparison	Number of patients	Results	Comments
Klosok et al. (1993) [23]	Chevron osteotomy versus Wilson osteotomy	87	Quicker return to work with Chevron osteotomy, better functional outcome with Wilson osteotomy	Three years' follow-up, Wilson osteotomy now hardly ever used
Resch et al. (1994) [24]	Chevron osteotomy with versus without adductor tenotomy	84	Hallux correction 9.8°/7.5° with/without tenotomy, no other differences	Limited relevance, because capsule not divided
Connor et al. (1995) [25]	Rehabilitation with versus without continuous motion after Chevron osteotomy	39	Mobility better with continuous motion	Only 90 days' follow-up, limited relevance for treatment
Easley et al. (1996) [26]	Curved versus proximal Chevron osteotomy	97	No significant differences regarding correction, but swifter and more reliable healing with proximal Chevron osteotomy	Only 2 years' follow-up, various fixation techniques, limited relevance for treatment
Calder et al. (1999) [27]	Suture versus screw fixation in Mitchell osteotomy	30	Better results with screws	Superior stability with screws was to be expected, Mitchell osteotomy now seldom used
Torkki et al. (2003) [28]	Surgery versus 1-year conservative treatment with or without orthesis	209	Surgery superior to conservative treatment after 1 year, no difference after 2 years	Unclear interpretation of data
Faber et al. (2004) [29]	Hohmann osteotomy versus Lapidus operation	101	No significant difference, also not with regard to hypermobility of first tarsometatarsal joint	No severe deformities included, only 2 years' follow-up
Saro et al. (2007) [30]	Lindgren versus Chevron osteotomy	100	No significant differences, both procedures suitable only for mild deformities	Long follow-up (6 years); comparison of two very similar techniques; Lindgren techniques now seldom used
Deenik et al. (2008) [31]	Scarf osteotomy versus Chevron osteotomy	136	No significant differences, good results in both groups	Comparison of two very similar techniques; the authors recommend Chevron osteotomy because it is technically simpler
Tonbul et al. (2009) [32]	Screw versus K-wires for stabilization; curved, distal metatarsal osteotomy	16	No significant differences, good results in both groups	Groups too small, limited relevance for treatment
du Plessis et al. (2011) [33]	Exercises versus night splint in conservative hallux valgus treatment	30	No difference between the groups	Groups too small
Pentikäinen et al. (2012) [34]	Chevron osteotomy with fixation (resorbable peg) versus no fixation, with plaster versus elastic bandage postoperatively	100	Osteotomy displacement 3.9 mm with fixation versus 3.1 mm without fixation (statistically significant), no difference for postoperative treatment	Accuracy of measurement technique not described, difference clinically irrelevant

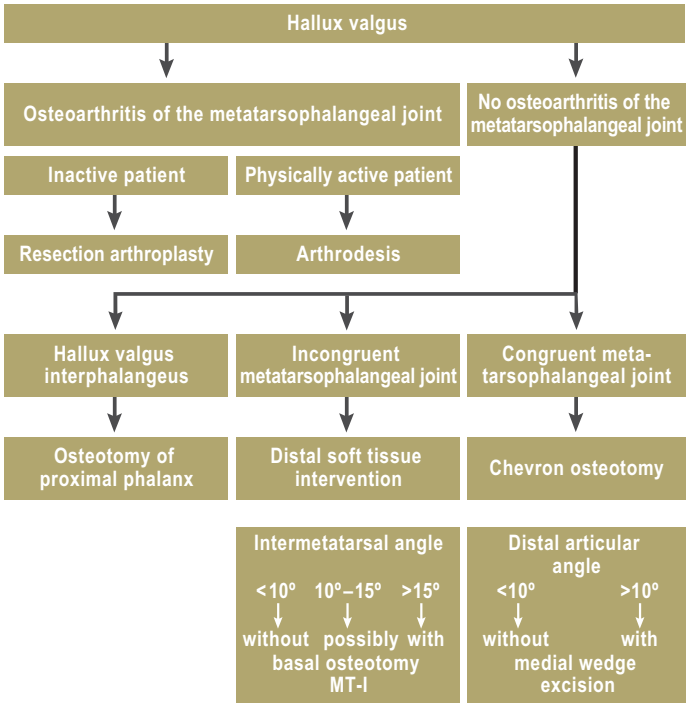
Operative techniques

Whether, for example, the adductor tendon should be divided or the intermetatarsal angle corrected has to be decided according to the individual deformity.

Trials

All randomized controlled trials had case numbers that were too small and follow-up periods that were too short.

FIGURE 3



The algorithm used at our institution to classify hallux valgus and select the most appropriate surgical procedure. This algorithm broadly corresponds to other published recommendations (36). Distal and proximal repositioning of metatarsal I and arthrodesis can be accomplished by means of various osteotomies and fixation techniques. MT-I, metatarsal I

inconsistent results; no one technique was superior to all others. Notably, in some studies 25% to 33% of patients were unsatisfied with the outcome of the operation although the relevant angles were improved. The authors of the Cochrane review criticized the maximal 3 years' postoperative follow-up, writing that 20 to 30 years would be desirable (35).

The German Orthopaedic Foot and Ankle Society (DAF), a section of the German Society for Orthopaedics and Orthopaedic Surgery (DGOOC), has issued an S1 guideline on hallux valgus (36). On the basis of studies yielding evidence of levels III and IV, an algorithm was set up that distinguishes between mild, moderate, and severe deformities and lists distal, diaphyseal, and proximal osteotomies and arthrodesis of the first tarsometatarsal joint as surgical options. Each procedure can be used for all deformities, with two exceptions: proximal osteotomy and arthrodesis should not be employed for mild deformities, and distal osteotomy is not appropriate for severe hallux valgus. The guideline includes the following recommendations without giving any references: division of the soft tissues lateral to the metatarsophalangeal joint in severe deformities; corrective retrocapital osteotomy in the presence of a tilted joint surface; resection arthroplasty in the case of poor mobility; shortening of metatarsal I in osteoarthritis of the metatarsophalangeal joint. Therefore, although the guideline is formulated in quite general terms, its recommendations essentially correspond to those given here. An example of the other reviews on the treatment of hallux valgus is that published by Wanivenhaus et al. (37).

In the face of the high number of different operations described and the mostly low level of evidence of the investigations published, it is extremely difficult to give treatment recommendations based on high-level evidence. The surgical procedures described in this review reflect the practice in our own institution. Other procedures that are not discussed here may be equally suitable, but any surgery must be specifically designed to eliminate the deformity concerned.

Indications for surgery

Cosmetic surgery is out of place in hallux valgus. The danger is far too great that a previously symptom-free patient will suffer pain for weeks or even months after the intervention. For surgical treatment to be indicated, the patient must have pain that is not alleviated by a simple change of shoes or by other, conservative treatments. Moreover, the pain must be regular in occurrence and must noticeably impair the function of the affected foot.

The pain does not necessarily have to involve the great toe itself. Patients often initially complain of pain arising from the other digits, which may already have been forced upwards as hammer or claw toes. In such a case it is not enough to correct the deformity of the smaller toes; the hallux valgus must be rectified.

The principal contraindication to surgery is arterial occlusive disease (e10). Because it is the part of the body most distant from the heart, the foot is the first place where decreased perfusion will make itself

Algorithm

Metatarsophalangeal joint with or without osteoarthritis, congruent or incongruent metatarsophalangeal joint, patient with high or low degree of physical activity.

Level of evidence

In the face of the high number of different operations described and the mostly low level of evidence of the investigations published, it is impossible to give treatment recommendations based on high-level evidence.

noticed. If the pedal pulse is not distinct, the vascular status must be determined. Only if sufficient perfusion is assured can surgery take place.

Diabetes, even with early polyneuropathy, does not represent a contraindication. Hallux valgus can also be treated surgically in the presence of chronic polyarthritis or other rheumatic diseases, although care must be taken to select an appropriate procedure.

Operative technique

The soft tissue covering of the foot is extremely thin, and this hampers wound healing. Furthermore, perfusion is poorest in the foot because of its distance from the heart. Finally, of all parts of the body the foot is subjected to the greatest mechanical stresses. For these reasons wound healing problems, depending on the extent of the operation and the patient's medical history, occur more frequently in the foot than in most other regions. The aim is uncomplicated wound healing in at least 99% of patients, in our experience an attainable goal. Particular care must therefore be taken when operating on the great toe. The duration of ischemia must be as short as possible. This is best achieved by wrapping a tourniquet around the foot after sterile draping. The incision should grant direct access to the operation site without undue dissection of soft tissues. There should be no hemostasis by means of electrocautery. Excessive retraction should be avoided. Care must be taken to ensure proper compression by the bandage applied postoperatively. Only dry bandages may be used in order to avoid maceration of the wound margins. The suture for wound closure should be left in place until 14 days after surgery. Although functional rehabilitation under full loading is generally possible, the foot must be elevated to avoid excessive swelling.

Surgical procedures

To be able to cope with all variants of hallux valgus, the surgeon needs a command of around four procedures. The basic distinction is between operations that restore the normal anatomy of the forefoot, and thus come into question particularly in younger patients, and interventions where the joint is sacrificed (resected or fused), which are considered especially in older patients and in the case of osteoarthritis of the metatarsophalangeal joint (12, 38, 39).

Figure 3 provides an overview of the classification of hallux valgus and the commonest surgical procedures. These will be described in detail in the following.

Figure 4: Radiographs of a foot with mild hallux valgus
a) Mild malposition with an intermetatarsal angle of 13°, a congruent metatarsophalangeal joint, and a flexible deformity
b) After correction by Chevron osteotomy: the head of metatarsal I was shifted 5 mm to lateral and the capsule on the medial side of the first metatarsophalangeal joint was tightened

Mild deformities

Mild deformities are found predominantly in young women *(Figure 4a)*. The patients complain principally of pressure pain in the bunion, which is moderately prominent. The deformity is flexible, i.e., the hallux can be restored to the normal position manually, without any significant resistance. Moreover, the metatarsus is only slightly splayed, so that the intermetatarsal angle is less than 15° on a weight bearing radiograph. The mobility of the first metatarsophalangeal joint is not restricted, and no osteoarthritis is seen on the radiograph. Mild deformities can be effectively treated by distal metatarsal I osteotomies, e.g., chevron osteotomy *(Figure 4b)*. This intervention, initially known as Austin osteotomy, was first described in 1962 (13). A V-shaped cut is made in the head of metatarsal I and the bone is displaced laterally by one third to a half of its width, thus correcting the intermetatarsal angle. In addition, the exostosis on the medial aspect of the head of metatarsal I is shaved off and the capsule tightened so that by the end of the operation the great toe is in the proper position. Fixation with a small implant is

Surgical procedure according to deformity

The success of an operation depends crucially on the selection of the best procedure for the individual deformity.

Contraindication

The principal contraindication to surgery is arterial occlusive disease.

Figure 5: Radiographs of a foot with severe hallux valgus
a) Severe deformity with an intermetatarsal angle of 19°, an incongruent metatarsophalangeal joint, and a rigid deformity
b) After correction by a distal soft tissue intervention with release of the soft tissues on the lateral side and tightening of the soft tissues on the medial side of the metatarsophalangeal joint, with additional correction of the position of metatarsal I by an osteotomy at its base

necessary to prevent reposition loss, but an inexpensive small-fragment screw or a wire will suffice. There is no consensus on the advisability of carrying out additional lateral release in the case of an incongruent metatarsophalangeal joint. We do not do so in the context of chevron osteotomy, for two reasons: (1) lateral release is unnecessary in mild deformities, and other procedures are available for more severe cases of hallux valgus; (2) lateral release increases the risk of poor perfusion of the head of metatarsal I with consequent necrosis. Postoperatively the toe must be held straight for 6 weeks with a corrective bandage. During this time the patient has to wear a flat-soled healing shoe that allows full weight bearing.

Severe deformities

Severe deformities mostly affect the middle-aged and elderly, predominantly women *(Figure 5a)* (1). The great toe can no longer be fully repositioned manually, and on radiographs the joint is seen to be incongruent, i.e. the proximal phalanx is subluxated laterally on the head of metatarsal I. The metatarsus is distinctly splayed, further increasing the prominence of the bunion on the medial aspect of the head of metatarsal I. The intermetatarsal angle is 15° or more on weight bearing radiographs (3). In this case the soft tissues lateral to the first metatarsophalangeal joint must be divided—this is termed lateral release. Various versions of this soft tissue intervention have been known for many years and were particularly recommended by McBride (21). The technique most widely used today was first described by Mann (11). An intermetatarsal angle of 15° or more necessitates an additional corrective osteotomy at the base of metatarsal I, where the potential for correction is greater *(Figure 5b)*. Many different osteotomy techniques have been described. The simplest are opening osteotomies that are then filled medially with bone, for example from the resected exostosis. At the same time, osteotomies in two planes provide greater stability, because the bony contact surface is increased and the danger of dislocation reduced. After correction the osteotomy has to be stabilized with an implant. Here too, an inexpensive cancellous screw suffices. We take the view that complicated, costly implants such as fixed angle plates are unnecessary. When closing the capsule on the medial side of the metatarsophalangeal joint, the surgeon must take great care to ensure that the capsule is sufficiently tightened after resection of the bony pseudoexostosis.

Hallux valgus et rigidus

Osteoarthritis of the metatarsophalangeal joint is usually found in older patients. On closer inspection, most patients aged 65 years or more with hallux valgus show articular degeneration *(Figure 6a)*. There is no longer any point in carrying out reconstructive procedures, because joint mobility is usually not adequately restored and long-term pain often results. The preferred procedure in physically inactive patients is therefore a very old intervention, namely resection arthroplasty with removal of the base of the proximal phalanx of the great toe (16, 17). The procedure is simple and the rehabilitation time short. In our experience the patients are moving around normally without special shoes within 4–6 weeks. One disadvantage is almost total loss of function of the great toe, which no longer has sufficient contact with the ground during the heel rise phase of gait. This frequently results in pain under the heads of the middle metatarsals, referred to as transfer metatarsalgia. Even pronounced deformities can be corrected, but generally

Mild deformities

Best suited for mild deformities are distal osteotomies of metatarsal I, particularly chevron osteotomy.

Severe deformities

Severe deformities necessitate soft tissue intervention around the first metatarsophalangeal joint, as a rule accompanied by an osteotomy at the base of metatarsal I.

an accompanying osteotomy at the base of metatarsal I is required *(Figure 7)*.

An alternative in patients with hallux valgus et rigidus who still have a high level of physical activity is arthrodesis of the joint. Contrary to the common expectation, arthrodesis is an operation that preserves function, because the great toe comes into firm contact with the ground during heel rise, relieving the metatarsal heads of the other rays. This means that a certain level of sporting activity is possible. A further advantage is the definitive positioning of the great toe. Thus arthrodesis can be considered especially for very pronounced deformities. In the presence of a greatly increased intermetatarsal angle, care must be taken to compress the metatarsus to enable proper adjustment of the angle between the proximal phalanx and metatarsal I. Fixation is achieved preferably with a dorsal plate *(Figure 6b)*. This departs from strict biomechanical principles, but is practicable and successful. A tension screw may be added.

Special cases

Occasionally there are special indications. If the distal phalanx of the great toe is angled to lateral (hallux valgus interphalangeus), osteotomy of the proximal phalanx with removal of a medial-based wedge is required (generally in addition to one of the procedures described above) (8). Absolutely accurate restoration of the angle is not possible, but if the wedge has a base of 1 to 3 mm the correction is usually adequate. Complicated and costly implants (staples, screws) are available, but adequate fixation can be achieved with a simple, inexpensive suture threaded through drill holes. Occasionally the joint surface at the head of metatarsal I is tilted to lateral, particularly in cases where the hallux valgus arose before the patient reached adulthood. The orientation of the joint surface must then be corrected by osteotomy involving removal of a medial-based wedge from the distal portion of metatarsal I.

Rehabilitation

In our institution all operations on the forefoot are followed by full weight bearing in a postoperative shoe with a flat, stiff sole that is worn for 6 weeks. Because of the frequent tendency towards swelling, patients are advised to keep the affected foot raised for much of the time during the first 2 weeks. After reconstructive interventions a corrective dressing must be worn for up to 6 weeks. The patient changes the dressing each day.

Figure 6: Radiographs of a foot with hallux valgus in a 68-year-old man
a) Osteoarthritis of the first metatarsophalangeal joint with narrowing of the joint space
b) After arthrodesis. The patient wears a postoperative shoe with a stiff sole for 6 weeks and unlimited weight bearing is allowed immediately after surgery

Patients can usually walk normally after 8 to 12 weeks. Implants can be removed from 6 to 9 months after surgery, but can be left in situ in elderly patients if they are causing no symptoms.

Conclusion

The literature contains practically no well-controlled prospective trials; in particular, no comparison of different treatment procedures. Analysis of the large number of retrospective studies with follow-up for up to 5 years shows that overall, 85% of patients are satisfied and have a good clinical result. Ten percent are less satisfied and show a less beneficial outcome, and in 5% the results of surgery are poor. This corresponds with our own experience. Foremost among the complications of reconstructive procedures are recurrences, sometimes as a result of inadequate surgical correction, sometimes because of poor wound healing (40). The quality of wound healing cannot be precisely predicted, and the rate of wound healing problems is generally stated as 2% to 4%; our experience, however, indicates that this figure should be lower. Pseudarthrosis and necrosis of the head of metatarsal I are rare (e11, e12).

Osteoarthritis

In the presence of osteoarthritis of the first metatarsophalangeal joint and in very elderly patients, resection arthroplasty or arthrodesis of the first metatarsophalangeal joint produce the best results.

Hallux valgus et rigidus

There is no longer any point in carrying out reconstructive procedures, because joint mobility is usually not adequately restored and long-term pain often results.

Figure 7: Radiographs of the right foot of a 75-year-old woman
a) Hallux valgus with slight narrowing of the joint space. The intermetatarsal angle is 17°
b) Because joint surface degeneration is regularly found at operation in patients of this age, the deformity was corrected by resection arthroplasty with a proximal osteotomy to correct the intermetatarsal angle

Conflict of interest statement
The authors declare that no conflict of interest exists.

Manuscript received on 30 March 2012, revised version accepted on 9 October 2012.

Translated from the original German by David Roseveare.

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Rehabilitation

As a rule rehabilitation is very functional, usually with full load bearing in a flat healing shoe.

Wound healing problems

The frequency of wound healing problems is generally stated as 2% to 4%.

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For eReferences please refer to:
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The solutions to the following questions will be published in issue 5/2013. The CME unit "The Diagnosis and Management of Dyscalculia" (issue 45/2012) can be accessed until 21 December 2012.

For issue 1–2/2012, we plan to offer the topic "Competitive sports and the heart: benefit or risk?."

Solutions to the CME questionnaire in issue 41/2012:
Schmidt-Chanasit J, et al.: Viruses acquired abroad—what does the primary care physician need to know?

Solutions: 1e, 2c, 3c, 4d, 5e, 6a, 7c, 8c, 9e, 10d

Please answer the following questions to participate in our certified Continuing Medical Education program. Only one answer is possible per question. Please select the answer that is most appropriate.

Question 1

The hallux valgus deformity consists principally of lateral deviation of the great toe. However, there are further deviations from normal forefoot anatomy. Which of the following is one of these?

a) A prominence on the medial aspect of the head of metatarsal V
b) Shortening of the Achilles tendon
c) Pronation of the whole foot
d) Widening of the metatarsus (splay foot)
e) Excessive shortness of metatarsal IV

Question 2

When surgical correction of hallux valgus is indicated, a further diagnostic examination is required. What is it?

a) Weight bearing radiograph in dorsoplantar projection
b) Magnetic resonance imaging of the forefoot
c) Bone scintigraphy
d) Lateral radiography of the forefoot without load
e) Sonography of the metatarsophalangeal joint

Question 3

How can lasting correction of hallux valgus deformity in an adult be achieved by conservative means?

a) Insoles with a pad
b) Soft shoes
c) Night splints
d) Cannot be achieved
e) Splay foot bandage

Question 4

When is surgical correction of hallux valgus indicated?

a) When high-heeled shoes can no longer be worn
b) When the symptoms regularly cause noticeable limitation of daily activities
c) When the radiograph shows a hallux valgus angle of more than 20°
d) When night splints do not improve the position of the great toe
e) When degenerative changes in the first metatarsophalangeal joint can be seen on magnetic resonance imaging

Question 5

Which of the following is most likely to contraindicate surgical correction of hallux valgus?

a) A peripheral perfusion disorder
b) Chronic polyarthritis
c) Diabetes mellitus
d) Bilateral hallux valgus
e) Osteoarthritis of the first metatarsophalangeal joint

Question 6

What is one of the characteristics of mild hallux valgus deformity?

a) Limited mobility of the first metatarsophalangeal joint
b) Simultaneous claw toe
c) A flexible deformity
d) An intermetatarsal angle of more than 15°
e) Osteoarthritis of the first metatarsophalangeal joint on radiography

Question 7

What is one of the findings in severe hallux valgus deformity?

a) An incongruence (subluxation) of the first metatarsophalangeal joint on radiography
b) An intermetatarsal angle of less than 10°
c) Osteoporosis
d) Absent pedal pulse
e) Simultaneous flat foot

Question 8

Which operation for hallux valgus is particularly suitable for older, inactive patients who also have painful osteoarthritis of the first metatarsophalangeal joint?

a) Chevron osteotomy
b) Distal soft tissue intervention with basal osteotomy
c) Distal osteotomy of metatarsal I
d) Corrective osteotomy of the proximal phalanx
e) Resection arthroplasty

Question 9

What should always be observed in operations for hallux valgus?

a) Extensive hemostasis by means of electrocautery
b) Loose wound bandage without compression
c) As little dissection of soft tissues as possible
d) Ischemia for as long as possible
e) Suture removal after about a week

Question 10

What is an advantage of Chevron osteotomy?

a) Complete soft tissue correction
b) Can be used in severe deformities
c) No implant necessary
d) Little soft tissue trauma
e) Good perfusion of the head of metatarsal I

CONTINUING MEDICAL EDUCATION

The Treatment of Hallux Valgus

Nikolaus Wülker, Falk Mittag

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